A2.2 AIR QUALITY

Fort Irwin is in the Southeast Desert Air Basin. The basin has been designated as a non-attainment area for photochemical oxidants and total suspended particulates.

It is believed that the existing oxidant problem in the Southeast Desert Air Basin may be due, in part at least, to the transport of ozone and precursor species from the heavily populated South Coast Air Basin. In October 1978, the Southern California Association of Governments and the South Coast Air Quality Management District jointly issued the draft Air Quality Management Plan for the South Coast Air Basin. This plan calls for a wide range of emissions control strategies designed to improve air quality in the Basin. It appears reasonable to anticipate that air quality in the Southeast Desert Air Basin will be favorably impacted by control and mitigation measures in the South Coast Air Basin.

High total suspended particulate (TSP) concentrations are related largely to the effects of wind on the dry desert surface. At Barstow, the nearest air quality monitoring site, federal primary standards were exceeded on 54 days in 1977. State standards were exceeded on 42 days for oxidant, one day for nitrogen dioxide, and 39 days for total suspended particulates.

A2.3 PHYSIOGRAPHY (See Figure 3)

A2.3.1 General

Fort Irwin is at the northern edge of the Mojave Desert Geomorphic Province, which has thick, non-marine Cenozoic deposits. This is separated from the Basin Ranges Geomorphic Province to the north by the Garlock Fault which has formed the Leach Lake trough across the northern portion of Fort Irwin. The Mojave Desert Geomorphic Province is dominated by broad alluviated basins. The closed basins are mostly depositional surfaces which receive continental deposits from adjacent uplands. On Fort Irwin, as throughout the Mojave Desert, the remnant peaks of mountains and hills rise above the alluvial fill of the valleys. Erosion continues to degrade the mountain sides, carrying rock debris down to be redeposited in the closed basins. The slopes of alluvium become more and more gentle and, at the lowest part, become virtually level on the intermittent lakes, called playas, found in nearly every internal drainage system.

Table A-3. Maximum Concentrations of Monitored Air Pollutants and Days Exceeding California Standards

Barstow, California - 1977

Pollutant	Maximum Concentration	Days Exceeding California Standard
Oxidant (O_x)	.20 ppm	42
Carbon Monoxide (CO)	4 ppm	0
Nitrogen Dioxide (NO_2)	.26 ppm	1
Sulfur Dioxide (SO_2)	18.6 ug/m^3	0
Total Suspended Particulates (TSP)	670 ug/m^3	39

Table A-4 Total Suspended Particulate Readings at Barstow, California, for Selected Months 1976-1977

Month	Monthly Minimum (ug/m^3)	Monthly Maximum (ug/m^3)	Monthly Arithmetic Mean (ug/m^3)
August 1976	85	182	131
September 1976	30	303	128
October 1976	N.A.	N.A.	N.A.
November 1976	78	138	107
December 1976	112	261	164
January 1977	N.A.	N.A.	N.A.
February 1977	44	137	82
March 1977	37	74	48
April 1977	46	87	66
May 1977	103	164	134

N.A. = Not Available

Source: Air Quality and Meteorology, Southern California, APCD, El Monte, California, Volume XXI, Nos. 7, 8, 9, 11, 12; Volume XXII, Nos. 2, 3, 4, 5.

Table A5 California and Federal Ambient Air Quality Standards

Pollutant	Units	Averaging Time	California Standard	Federal Standards Primary*	Federal Standards Secondary**
Oxidant	ppm	1 hour	0.10	0.08	0.08
Carbon Monoxide	ppm	8 hours	-	9	9
		1 hour	40	35	35
Nitrogen Dioxide	ppm	Annual Average	-	0.05	0.05
		1 hour	.25		
Sulfur	ppm	Annual Average	-	0.03	-
Particulate Matter	ug/m^3	Annual Average	60	75	60
	ug/m^3	24 hours	100	260	150
Hydrocarbons	ug/m^3	3 hours (6-9am)	160	160	

ppm = Parts per million.

u/m^3 = Micrograms per cubic meter.

Source: California Air Resources Board.

*To protect the public health.

**To protect the public welfare from any known or anticipated adverse effects.

Figure A-1 is a schematic diagram of a typical internal drainage system on Fort Irwin, showing the principal land-forms.

A2.3.2 Relief

The highest elevations in the Fort Irwin Reservation are in the Avawatz Mountains where peaks rise to 1,876 meters (6,154 feet). The lowest elevations of the base are around 518 meters (1,780 feet), in the vicinity of Bitter Springs. Elevations of mountain ranges and playas on Fort Irwin are shown in Table A6.

Elevations on Fort Irwin are generally higher than lands to the north and east of the reservation. On the northern side of the Avawatz Mountains elevations drop off to less than 500 feet and as low as -86 meters (-282 feet) in Death Valley some 30 miles north.

A2.3.3 Slope

The topography of Fort Irwin can be divided based upon slope into four classes: flat; gently rolling; hilly, and mountain-ous. The areas these represent for Fort Irwin are shown in Table A-7.

Flat and gently rolling topography can be easily traversed by tracked vehicles and properly equipped wheeled vehicles. Established roads tend to be straight and they cut directly across the smooth alluvial surfaces. In hilly areas, road-ways tend to conform to the topography. Vehicles find travel easier on established roadways. In mountainous topography, wheeled and tracked vehicles are highly restric-ted in their movements and must travel on the few estab-lished roadways such as those that lead across mountain passes from valley to valley. The Fort Irwin terrain is fully trafficable by foot troops, 50 percent trafficable by wheeled vehicles and 60 percent trafficable by tracked vehicles.

A2.4 HYDROLOGY (See Figure 3)

A2.4.1 Water Supply

A. Surface Water Resources

There are no permanent streams at the Fort Irwin Military Reservation. Surface water flow occurs only after intense rainfall periods, mainly in the form of flashfloods and as snow melt on occasions. Most of this water flows on the surface for only short periods of time before infiltrating

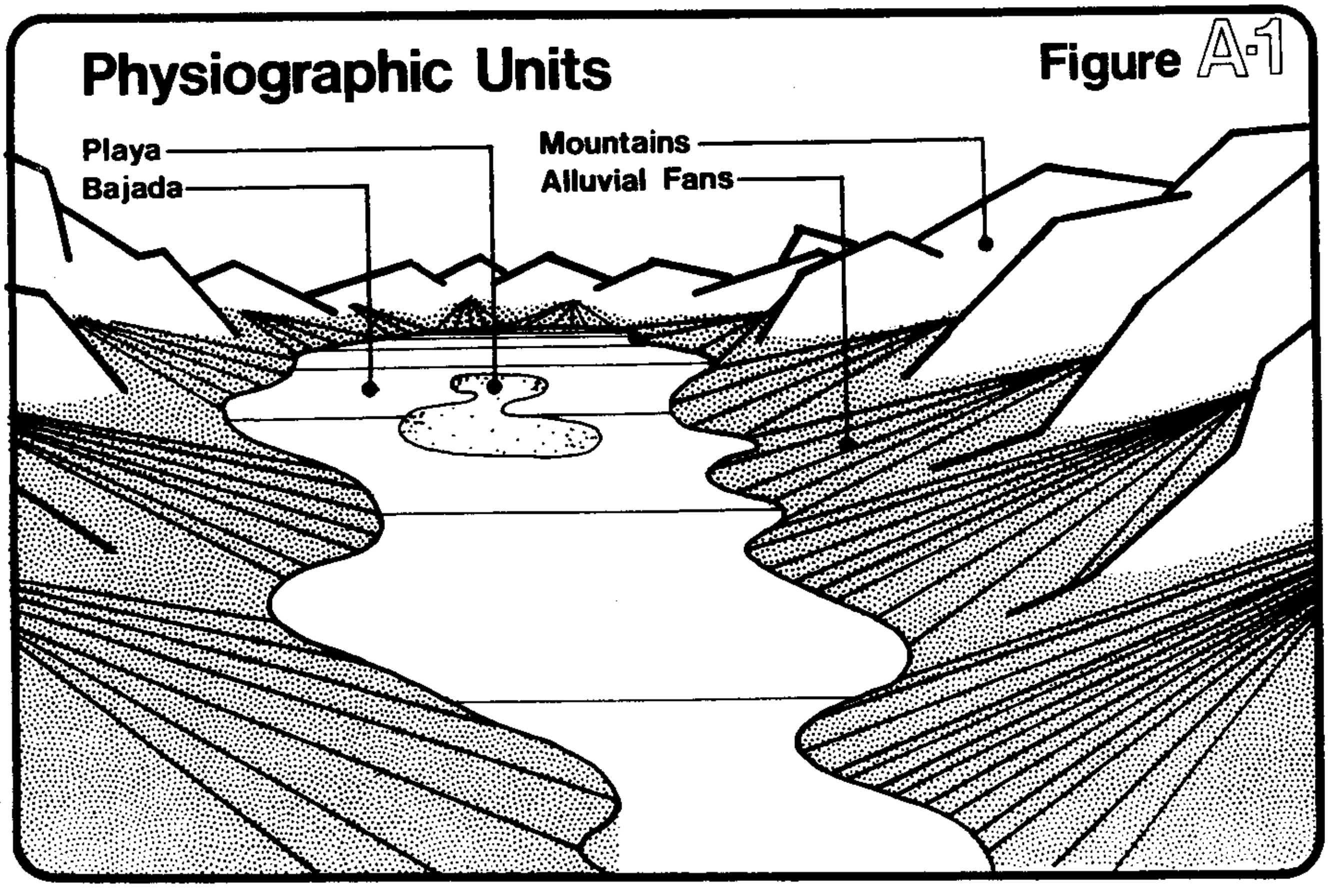
Physiographic Units
Figure A-1
Playa
Bajada
Mountains
Alluvial Fans

Table A-6 Mountain Ranges and Playas of the Fort Irwin Reservation

Mountains	Maximum Elevation Feet	Meters	Location
Avawatz Mountains	6154	1876	In N.E. quadrant of Fort Irwin
Tiefort Mountains	4400	1341	5 miles east of the cantonment area
Granite Mountains	5299	1615	In N.W. quadrant of Fort Irwin
Quail Mountains	4707	1459	Extreme N.W. of Fort Irwin Reservation
Paradise Range	3621	1104	Extreme S.W. corner of Fort Irwin Reservation
Alvord Mountain	3456	1053	Just south of Fort Irwin boundary
Soda Mountains	3617	1102	Just southeast of Fort Irwin Reservation

Playa	Approximate Elevation of Lake Bed Feet	Meters	Location
Leach Lake	1920	585	Inside N. boundary of Fort Irwin Reservation
McLean Lake	3115	949	S. of Granite Mountains in N. of reservation
Nelson Lake	3050	930	5 miles S. of McLean Lake
Drinkwater Lake	3350	1021	Near Avawatz Pass in N.E. of Fort Irwin Reservation
Goldstone Lake	3022	921	W. central portion of reservation
Bicycle Lake	2350	716	2.5$\pm$ miles N.E. of cantonment area
Red Pass Lake	1858	566	E. edge of reservation
Langford Well Lake	2160	658	5$\pm$ miles S.E. of cantonment area
Coyote Lake	1703	519	4$\pm$ miles S. of S. boundary of reservation

Source: U.S.G.S. Topographic Maps, 15-minute series.

Table A-7 Topography Classes on Fort Irwin

Topography Class	Slope Percent	Approximate Area in Class (mi^2)	(km^2)	Percent
Mountainous	45%	172	445	18
Hilly	20-45%	196	508	20
Gently Rolling	10-20%	112	290	11
Flat	10%	500	1295	51
TOTAL AREA		980	2538	100

Note: Topography classes were determined by measurement of steepest slope within a 2 x 2 mile grid cell superimposed upon the U.S.G.S. 2:250,000 scale, Trona, California Sheet (revised 1969)

Source: EDAW, Inc. and Earth Sciences Associates, 1974. Project Sanguine Site Selection Data, Fort Irwin Military Reservation, California. San Francisco: EDAW, Inc.

into the dry desert soils or evaporating. Some water reaches playas (dry lake beds) which become inundated for short periods. Surface water from these sources is not a reliable nor appropriate supply for general use both because it occurs intermittently, and the chemical quality of the water is typically not good. High quantities of suspended and dissolved solids and high concentrations of salts due to evaporation in playa lakes are the main causes for the poor quality.

Some water can be obtained at or very near the surface of the ground from springs. These occur at only a few isolated spots throughout the reservation.

Several springs do occur within and in the immediate vicinity of the reservation. The current status of these springs is not known. A 1943 study of water resources for the Camp Irwin Reservation (Poland and Worts, 1951) included examinations of nine of the larger springs within the reservation boundary. Several of these springs were developed in 1944, and substantial storage was provided in underground redwood tanks. The flow of these springs and their storage facilities were as follows:

Spring	Flow (gpm)	Storage Capacity (gallons)
Two Springs	2	25,000
Desert King Spring	10	30,000
Leach Spring	1-1/2	4,000
Taylor Spring	1/3	2,300
Garlic Spring	2	25,000

B. Subsurface Water Resources

The Fort Irwin Military Reservation obtains all its water from 11 wells located within the reservation area. About 700,000 to 1,000,000 gallons are pumped monthly from the Fort Irwin area to the Goldstone facilities. Eight wells are located within the main cantonment area, and three are located in the immediate vicinity of Bicycle Lake. Of these 11, only nine are presently active, six in the cantonment area and three near Bicycle Lake.

Previous hydrologic investigations (mainly Poland Worts, 1941; Kunkel and Riley, 1954; Hosturp & Associates, 1955 and 1958; Department of Water Resources, 1963, 1964, 1967, 1969, and 1971) as well as various U.S. Army Corps of Engineers memoranda on well drilling indicate that groundwater occurs principally in alluvial deposits underlying valleys and basins within the reservation. These alluvial materials consist of mixtures of clay, silt, sand, gravel, and boulders, distributed in layers and irregular lenses which reach aggregate thicknesses of several hundred feet. The alluvial materials have been derived from the adjacent mountains which are composed mainly of volcanic and granitic rocks.

The eight wells located within the main cantonment area tap artesian aquifers contained in a closed alluvial valley. When water levels drop due to pumpage, the aquifers reach free water table conditions. At the well sites, the saturated aquifer zones are 170 to 360 plus feet thick and are capped by a confining bed of low permeability which ranges in thicknesses between 130 and 245 feet. The elevation of the piezometric surface was about 2,280 in July, 1974. The lowest recorded level was about 2,271 in May, 1970.

The Irwin Basin of 29.8 square miles is recharged by precipitation which is not lost by evaporation, transpiration, or surface runoff into Langford Valley. Recharge for the Irwin Basin was estimated at 48.5 million gallons (149 acre-feet) per year for the 10-year period 1941-1951 (Hostrup & Associates, 1955, p. 84). The basin yield excluding basin recharge was estimated to be 23,168 million gallons (71,089 acre-feet) above elevation 2,150.

Recharge conditions of the Bicycle Lake groundwater basin are similar to those of the Irwin basin, but because the surface drainage area is about 134 square miles, including Dry Gulch, the rate of recharge is estimated at 218.2 million gallons (669 acre-feet) per year (Hostrup & Associates, 1955, p. 93). The basin yield was estimated to be 63,800 million gallons (195,766 acre-feet) above elevation 2,100, excluding basin recharge.

Of several groundwater basins explored as additional water sources for Fort Irwin, only two, Langford Lake and Coyote Lake, have been shown to have realistic potential.

- Langford Lake basin, immediately to the southeast of the main post area, has a surface drainage area of about 41 square miles. The groundwater basin contains aquifers under free water table conditions at depths ranging from about 100 to 487 feet as shown in an exploratory well drilled in 1954. The water level in that well between January and May 1970 was at an average depth of 86.5 feet (Elevation 2,109.8). Average recharge rate of the Langford Lake basin was estimated at 67.2 million gallons (206 acre-feet) per year. The basin yield was estimated at 43,600 million gallons (133,783 acre-feet) above elevation 1,908, excluding recharge.

- The other explored basin is Coyote Lake, about 22 miles south of the main post area. Several domestic wells exist in that area. A 584-feet deep exploratory well on the west side of Coyote Lake was drilled and tested in 1954 for future well sites. Tests indicated that free water is available in that area. The water level was at an average depth of 58 feet between January and May, 1970 (Elevation 1,731.50). On the basis of a total surface drainage area of 320 square miles, the rate of recharge is estimated at 450 million gallons (1,381 acre-feet) per year. The basin yield was estimated at 409,900 million gallons (1,257,748 acre-feet) above elevation 1,450, excluding recharge and neglecting possible influence from the adjacent Mojave River basin (Hostrup and Associates, 1955, p. 94).

At present, about one-half of the water used at Fort Irwin is obtained from the eight wells located in the cantonment area. The Irwin groundwater basin is contained within the surface drainage area of Langford Lake. The basin covers a 29.8 square mile area and varies in elevation between about 2,160 feet at the lake level and about 3,400 feet in the mountains northwest of the cantonment area. The land surface within the area tapped by wells is at an elevation of about 2,500 feet. The wells reach depths that range between 430 (Well No. 4) and 750 (Well No. 8) feet and draw water from alluvial aquifers at depths from about 200 to about 750 feet. The combined pumping capacity of the eight wells is 2,649 gallons per minute (U.S. Army Corps of Engineers, 1975).

Three other wells are in the surface drainage basin of Bicycle Lake which covers an area of about 134 square miles. The Bicycle Lake groundwater basin covers an area of about 27 square miles. Elevations in the basin range between about 2,310 feet at the dry lake floor and about 5,300 feet in the Granite Mountains to the north of the lake. The three wells (B-1, B-2, and B-4 of Figure 3) are located about 1½ miles north of the northern edge of the dry lake at elevations between 2,395 and 2,400 feet. These wells reach depths that range from 600 to 614 feet. Casing in these wells is perforated from depths of 180 to 594 feet. The combined pumping capacity of these three wells is 2,040 gpm (U.S. Army Corps of Engineers, 1975).

The static water level in all active wells within the reservation has dropped significantly since they were drilled.

The static water level in the first six wells of the main cantonment area was at an average elevation of 2,296.9 feet for the period 1941-1943, and had recovered to elevation 2,297.3 in February, 1951. On February 15, 1955, the average elevation of the static water level in these wells had dropped to 2,291.7 (Hostrup and Associates, 1955, p. 17). Water level measurements made in 1974 by Southern California Edison Company during pump tests indicated that the static water level at that time was at an elevation of about 2,280-2,281. The drop in water levels in the wells of the Bicycle Lake area has also been considerable. The level was at elevations of 2,197 to 2,221 when the wells were drilled in 1964-1965, and it had dropped to elevations of 2,166 to 2,212 by July 12, 1974.

A2.4.2 <u>Water Use</u>

Water use on the Fort Irwin Reservation has varied significantly since the base was established in 1940. As water production increased between 1941 and 1955, the mean altitude of the piezometric surface decreased (Hostrup and Associates, 1955, p. 17).

The water level has been estimated to decrease about one foot for every 50-100 million gallons of water withdrawn from the Irwin groundwater basin (Poland Worts, 1951, Hostrup and Associates, 1955; California Davis, 1977). When the rate of water extraction decreases, the water level rises, indicating that recharge does occur.

The drop in static water level is dependent upon both the recharge to the groundwater reservoirs and the use of water at the reservation. During the period 1941-1945, six wells produced a cumulative total of about 383 million gallons (1,175 acre-feet) of water, and the regional water table dropped an average of four feet. Between 1946 and 1951, the wells produced a cumulative total of only about 186 million gallons (571 acre-feet) of water, and the regional water table rose four feet to essentially the same level when the wells were drilled. In the seven year period of 1952-1957, the water withdrawn amounted to about 1,139 million gallons (3,495 acre-feet) which resulted in a two-foot drop in the water level. From 1958 through 1963, water production at Fort Irwin reached a cumulative total of 1,705 million gallons (5,232 acre-feet), and the water table dropped a total of 21.2 feet to average elevation 2,274.2 (USCE memorandum, 1964). The pumpage record indicates that between 1964 and 1971 about 2,547 million gallons (7,815 acre-feet) were withdrawn from the Irwin basin and 1,332 million gallons (4,087 acre-feet) from the Bicycle Lake area (Post Engineer Records). Complete pumpage data for the period 1972 to 1974 are not available in the Post Engineer's office files, but available related data suggest that yearly water use in that period was much less (perhaps one-third of the previous yearly use). This is reflected in the fact that the water table records in 1974, presented in Table A-8, had risen to about elevation 2,280 in the Irwin cantonment area. The water table has dropped about 15 feet in the Irwin basin since 1956 when the groundwater basin was essentially full. The total water extracted from the Irwin basin since 1956 is about 4,591 million gallons.

No groundwater level measurements are available for the period July, 1974 to the present. However, since water pumped in ten months of 1976 amounted to 178 million gallons (546 acre-feet) and the present rate of pumpage is equivalent to about 144 million gallons (442 acre-feet) per year, it is probable that the static water level may either have risen some above the 1974 level of 2,880 feet or has remained about the same due to the drought conditions of the past two years.

A2.4.3 Water Quality

In general, water from wells and springs within the reservation is potable, although generally high in fluorides and occasionally high in iron, boron, and nitrates. Water from all wells is chlorinated and goes to a storage and distribution system. Water consumed in the main housing area passes through a fluoride treatment plant to reduce fluoride content to acceptable limits. Non-potable groundwater is used for irrigation, to wash equipment, in water evaporators and for shower stalls.

Chemical analyses of water samples taken in 1973 and 1974 from well numbers five and seven in the Irwin area and from Wells B-1 and B-4 of the Bicycle Lake Basin are presented in Table A-9.

A2.4.4 Sewage Treatment and Disposal

Sewage produced at the main cantonment area is treated at a primary treatment plant placed in operation in 1954 and located about 1½ miles east of the main cantonment area (this and most of the following information has been condensed from a June 13, 1977 letter from Headquarters, Reserve Components Training Center, California National Guard, Fort Irwin to the California Regional Water Quality Control Board, which included a sanitary engineering special study of sewage treatment and disposal at Fort Irwin in January, March and April, 1969. No significant changes to facilities have occurred since). The facilities were

Table A-8 Water Production

Year	Irwin Basin Total Yearly Pumpage 1000 gals.	Irwin Basin Total Yearly Pumpage Acre-Feet	Bicycle Lake 1000 gals.	Bicycle Lake Acre-Feet	Average Altitude Static Water Level (ft) (Irwin Basin)
1957	229,406	703.92			2295.3
1958	223,397	685.48			
1959	213,235	654.30			
1960	243,044	745.76			
1961	286,932	880.43			
1962	364,291	1117.80			
1963	373,352	1145.60			2274.2
1964	391,358	1200.85			
1965	424,839	1303.59			
1966	491,313	1507.56			
1967	269,243	826.15	267,633	953.38	2279.6
1968	248,766	763.32	266,951	819.12	2285.1
1969	236,847	726.75	310,708	953.38	2285
1970	178,913	548.98	291,858	895.54	2271.5 (May 1970)
1971	118,432	363.40	198,069	607.76	
1972	N/A	-	N/A	-	
1973	N/A	-	N/A	-	
1974	N/A	-	N/A	-	2280.5 (July 1974)
1975	N/A	-	N/A	-	
1976	77,034 e	236.37	128,043 e	329.89	
1977	20,782	63.77	40.075	122.97	2280 ?

e = estimated from incomplete record.

Source: Post Engineer's records.

Table A-9 Chemical Analyses of Groundwater

Constituent	Unit	Well 5	Well 7	Well B-1	Well B-4	Drinking Water Standard
Alkalinity (as $CaCO_3$)	mg/l	114.0	302.30	148.0	154.0	
pH	pH Units	7.6	7.3	7.4	7.6	
Hardness (total as $CaCO_3$)	mg/l	44.0	68.0	120.0	76.0	
Calcium	mg/l	18.0	22.9	44.0	26.0	
Potassium	mg/l	10.9	1.05	13.7	32.0	
Silica	mg/l	28.0	29.4	33.0	40.0	
Specific Conductance	mmhos	760.0	-	842.0	815.0	900-2,200
Total Dissolved Solids	mg/l	517.0	592.0	576.0	584.0	500-1,500
Fluorides	mg/l	7.40	9.00	1.90	2.00	0.6-2.4 (temperature dependent)
Iron	mg/l	5.54	.09	.01	.06	0.3
Magnesium	mg/l	2.20	3.50	10.70	4.40	
Manganese	mg/l	.06	.00	.003	.01	0.05
Chlorides	mg/l	72.00	80.00	94.00	65.00	250-600
Sulfates	mg/l	127.00	155.00	87.0	123.00	250-600
Arsenic	mg/l	-	.000	.010	-	0.05
Barium	mg/l	-	-	-	-	1.
Boron	mg/l	1.200	2.200	1.70	1.35	
Cadmium	mg/l	.001	.003	.001	.001	0.010
Chromium	mg/l	.010	.000	.010	.010	0.05
Copper	mg/l	.010	.000	.010	.010	1.0
Lead	mg/l	.010	.018	.010	.010	0.05
Mercury	mg/l	.0005	-	.0011	.0004	0.002
Nitrates (as N)	mg/l	3.80	-	3.80	5.30	10.
Silver	mg/l	.010	.000	.010	.010	0.05
Sodium	mg/l	149.000	10.000	138.000	144.000	
Zinc	mg/l	.010	.000	.010	.090	5.0
Date Collected:		4 Jan. 74	4 Apr. 73	19 Sept. 73	7 Jan. 74	

Chemical analyses from Post Engineer's records.
Drinking water standard from: California Domestic Water Quality and Monitoring Regulations (proposed, in process of Public Hearings), and EPA National Primary Drinking Water Regulations (Federal Register, Vol. 40, No. 248, December 24, 1975).

designed to support a population of 10,000 people on a daily basis. They consist of a collection system which conveys the sewage to two primary clarifiers, a single-staged heated digestor, and a grease pit. Solids are conveyed to a sludge drying area and the liquid effluent to five oxidation ponds. In the past, effluent was used to irrigate a golf course located immediately east of the treatment plant. The golf course area is not being used at present and is not being irrigated. Effluent in the oxidation ponds does not currently overflow and is eliminated entirely by natural evaporation (Herbert Smith, personal communication, June 16, 1977).

At higher use levels, when the oxidation ponds are full and evaporation does not reduce the volume of effluent to prevent overflow, the effluent is conveyed to "Wet Lake", an impoundment in a topographical depression south of the golf course. A recreation area nicknamed "Engineer Park" has been developed adjacent to the lake for use by post residents. Water contact is discouraged by signs warning of "contaminated water".

In 1969, a sanitary engineering study showed that evaporation losses were approximately 15% of the average influent volume (363,000 gallons per day). The maximum daily evaporation losses were estimated at 37% of the average influent volume. The mean flow rate for 1976 was about 1.352 million gallons per day, and the mean flow rate for the months January through April 1977 was 1,288,360 gallons per day. The five oxidation ponds at the treatment plant have a storage capacity of 14,050,000 gallons.

A2.5 SURFICIAL GEOLOGY

A2.5.1 General

Figure 4 depicts Fort Irwin's surficial geology. The Mojave Desert is a Cenozoic feature formed as early as the Oligocene Epoch presumably from movements related to the San Andreas and Garlock faults (Norris and Webb, 1976). Fort Irwin contains numerous depositional basins between mountains.

Fort Irwin's mountain blocks, the Tiefort Mountains and Granite Mountains, are primarily granite intrusives. The Avawatz Mountains are composed primarily of Precambrian metamorphic rocks older than 600 million years.

There are some volcanics and intrusives of Tertiary Age (1 to 70 million years ago) to the west of the cantonment area toward Goldstone Lake and extending westward and into the

Naval Weapons Center. The volcanics include basalt flows, andesites, pyroclastics (volcanic tuff and breccia), plugs and dikes (Jennings, C. W. et. al., 1962; Geologic Map of California, Olaf P. Jenkins Edition, Trona Sheet).

A2.5.2 Faulting

The Garlock fault, which crosses the northern portion of Fort Irwin, forms the northern boundary of the Mojave Desert. The Garlock fault is the second largest fault in the state extending some 150 miles. The fault exhibits left-lateral displacement which has been estimated at 80 meters during Holocene time (the past 10 thousand years) (Clark, M.M. and Jajioie, K.R., 1974).

Other fault traces on Fort Irwin show parallelism with the Garlock fault.

A2.5.3 Seismicity

Fort Irwin is rated as Zone 3 in seismic risk (Algermissen, 1969) which is defined as a zone susceptible to damage corresponding to Modified Mercalli (MM), Intensity VIII or greater.

- <u>Intensity VIII, Modified Mercalli Scale</u>: General fright, and alarm approaches panic. Persons driving cars are disturbed. Trees shake strongly, and branches and trunks break off (especially palm trees). Sand and mud erupts in small amounts. Flow of springs and wells is temporarily and sometimes permanently changed. Dry wells renew flow. Temperatures of spring and well waters vary. Damage slight in brick structures built especially to withstand earthquakes; considerable in ordinary substantial buildings, with some partial collapse; heavy in some wooden houses, with some tumbling down. Panel walls break away in frame structures. Decayed pilings break off. Walls fall. Solid stone walls crack and break seriously. Wet grounds and steep slopes crack to some extent. Chimneys, columns, monuments and factory stacks and towers twist and fall. Very heavy furniture moves conspicuously or overturns. The frequency of occurrence is not considered in this classification.

The State of California has recently issued several maps to augment Algermissen's Seismic Risk Map. The California Division of Mines and Geology map of Earthquake Intensities shows Fort Irwin in an area that has experienced earthquake intensities of VI, VII, or VIII one to five times from 1810 to 1969.